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GEOLOGY'S DEBT TO THE MINERAL INDUSTRY[1]

OF recent years it has come to be acknowledged more and more that the science of geology has done and is doing much to advance the mineral industry. On the other hand, it may be of interest to consider briefly what bearing the industry has had on the advancement of the science. In what state of development would geology now be were it not for the assistance it has received from the mineral industry?

In the earlier ages of man the chief interest taken in the components of the earth's crust, in most regions, was, doubtless, chiefly what may be called an economic one. Suitable specimens of flint and other rocks were sought for the manufacture of weapons and utensils. The soft oxides of iron and other paint materials would also early attract attention. In volcanic and earthquake regions other interests would be aroused. Gradually a knowledge of the use of metals would be developed and methods of extracting certain of them from the ores would be discovered by accident. In later ages the economic interest became subordinate to the philosophical. For many centuries little progress could be made in a proper knowledge of the earth's crust until restraining prejudices were gradually thrown aside. It was only at the close of the 18th century that the struggling science began to make real progress. Whatever may be thought of the relative merits of the so-called Neptunists and Plutonists of that time, it cannot but be admitted that Werner was largely responsible for creating a keener and more widespread interest in the proper study of the earth's crust than had existed prior to his day. And this interest was aroused chiefly through his showing that a knowledge of the structural relations of rocks could be applied to economic purposes. Thus, in what

[1] Address of the vice-president and chairman of Section E—Geology and Geography, American Association for the Advancement of Science, Boston, December, 1922.

is acknowledged to be the very beginning of the science of geology as distinguished from cosmogony, credit has to be given to the mineral industry. No less an authority than Lyell makes this acknowledgment when he says in the Principles: "The phenomena observed in the structure of the globe had hitherto served for little else than to furnish interesting topics for philosophical discussion: but when Werner pointed out their application to the practical purposes of mining, they were instantly regarded by a large class of men as an essential part of their professional education, and from that time the science was cultivated in Europe more ardently and systematically." And Sir A. Geikie has said "the devout Wernerian put mines before mountains as a field for geological investigation."

As further illustrating the fact that the founders of geology were much interested in the application of the science, the case may be cited of the "father of geology," William Smith, who lamented "that the theory of geology was in the possession of one class of men, the practice with another." Another example is that of Logan, usually considered to be the father of pre-Cambrian geology, who said of himself: "For many years of my life engaged in the active pursuits of a practical miner for coal, and a practical smelter of copper from its ores, my connection with geology relates more to the application of materials."

A well-known trait in human nature is that when people have become wealthy, especially if they have inherited their wealth and taken on airs more or less aristocratic, they tend to look down on trade and tradesmen. The same characteristic is observed among geologists. Although the science owes so much to its economic aspects, there is a tendency among many men to avoid having anything to do with the applications of the science. This does not apply so much to geologists in North America as to those in older countries, but even on this continent there is a tendency to make two groups, "economic geologists" and "geologists."

The tendency in some countries is exemplified by the case of a well-known professor, who was even a lecturer in a school of mines. In referring to the dangers to be encountered in economic geology he is quoted as saying "You cannot touch pitch without some of it sticking to you." Another distinguished geologist considered it to be *infra dig* for a colleague to give advice on water supply. In another case, a well-known geologist was told by his colleagues that it was not seemly for him to become an officer in a mining society. Further, is it not a fact that if geological papers are published by mines departments, or by mining journals, they usually become known only to those interested in the applied science? Many geologists appear to avoid reading anything that is published under the heading of mines and mining.

A recent writer, referring to work of geological surveys, says that they do provide for some research in pure science, and the by-product of pure science from both public and private work is large. This illustrates the mental attitude which too many geologists have toward government surveys. Are the scientific results obtained from the work, undertaken primarily for economic reasons by the U. S. Geological Survey, in the Lake Superior region, for instance, not entitled to be considered more than mere by-products?

Apropos of the prejudice against economic work, R. W. Brock has said "Geology started as economic geology . . . [But later] it became *infra dig* for a geologist to do anything that would be of value to anybody. He would no more think of applying geology to practical purposes than an artist would of contracting to paint an advertisement. . . . I remember when I was leaving the European university where I had been studying, the old professor under whom I studied said to me, "You are going to America, you will be in great temptation; I know they will try to make use of you in mining; whatever you do, have nothing to do with economic geology."

The advantages accruing to pure science from work undertaken chiefly in connection with the mineral industry is well illustrated in the Lake Huron-Lake Superior region. While Logan made a good start in unravelling the age relations of the Canadian pre-Cambrian rocks, he and his assistants were succeeded by men most of whom have been described by Van Hise, as regards the work of the pre-Cambrian, as "chromatic" map makers, the rocks being mapped largely according to their colors and not according to their age and structural relations. Little

progress was made for many years after Logan's time, or not until some time after the discovery of important ore bodies at Sudbury and later at Cobalt and Porcupine. The finding of gold in the extreme western part of the Province also led to some important work there. If it had not been for the discovery of these valuable mineral deposits in the pre-Cambrian of Ontario, it is doubtful if much more would now be known regarding the age relations of these rocks than was known in Logan's time. Not long after Logan and his assistants ceased work in the pre-Cambrian the science of petrography arose. This science attracted many students of geology who would otherwise probably have done work on the stratigraphy of the pre-Cambrian in Canada. But the fascination of the new branch of science caused work in stratigraphy in regard to these most ancient rocks to be neglected. The students of petrography were interested in the minute structure of rocks, especially those of an igneous nature, and paid little or no attention to the age relations of the great masses of more or less metamorphosed sediments on which the history of the pre-Cambrian is so largely based.

But, while for many years after Logan's time little progress was made in the study of the Canadian pre-Cambrian, good work was being done on the United States side of Lake Superior by Pumpelly, Irving, Van Hise and others whose names will always be associated with the history of the development of these rocks. While the Ontario side was in darkness the lamp was kept burning on the American side, chiefly owing to the great copper deposits of Michigan and the iron mines of that and adjacent states.

Thus, were it not for the mineral industry in these Lake Superior States, probably even there little advance would have been made in the study of the pre-Cambrian beyond what was known in Logan's time. It was only the mineral industry that brought the expenditure of such large sums of money on both sides of the boundary in connection with the study of the pre-Cambrian. It is owing to the work of a large number of men, provided with excellent facilities, during the period of seventy years or more that progress has been made. It is fortunate for the science that these old rocks contain mineral deposits of exceptional value and interest—the greatest iron deposits, the greatest nickel deposits, and some of the greatest copper, silver and gold deposits that have ever been discovered in any country.

Referring to the Ontario side of the boundary it may be said that at Sudbury a knowledge of pre-Cambrian stratigraphy was not so important from an economic point of view as was the distribution and nature of the igneous rocks, more especially the norite, but at Cobalt much depended on stratigraphy, while at Porcupine and Kirkland Lake stratigraphy was again not so important. It may be of interest to add that one important result of the work, during recent years, in these mining areas has been the proving that the commonly accepted dual classification of the pre-Cambrian into Proterozoic and Archeozoic has no basis in fact and should be discarded. There are at least three major groups among these rocks.

The assistance which geology has received from the mineral industry is no better illustrated anywhere than in South Africa. In the early days of settlement in Cape Colony the existence of payable minerals was unknown, and the pioneers had difficulty in making headway with nothing valuable at hand for export or exchange. The discovery of diamonds in 1870 brought about a rapid change in conditions, as did also the discovery of gold in later years in the Transvaal. Had it not been for the discovery of the unsurpassed mineral deposits in the southern part of the continent the Boer farmer would still be occupying it in practically a pristine state. Is not the science of geology greatly indebted to the mineral industry in that part of the continent? Were it not for mining, the character and the wide distribution of those wonderful intrusives, the diamond "pipes," would have remained unknown in our time and for long after. Then, again, what a marvellous series of ancient sediments has been brought to light in the greatest gold field ever known, that of the Witwatersrand. Were it not for mining operations extending to great depths and laterally to great distances, the nature of these sediments, and especially of the comparatively thin beds of conglomerates, could never have been determined. Certain of these beds of conglomerate, that are the most important from a gold miner's point of view, have been proved to be

the most persistent beds of the kind known in the world. But it must be borne in mind that no similar bed has ever offered the same inducement for complete investigation. The comparatively thin bed known as the Main Reef Leader has been proved to be practically continuous over a distance along the strike of at least forty miles and probably has a corresponding extension in the direction of the dip. Its nature could not possibly have been ascertained were it not for the extensive mining excavations and the numerous bore holes that have been put down over a large area in the search for productive gold-bearing rock.

These sediments, with which are associated the gold "reefs" or beds of conglomerate, have a thickness in the central part of the Rand of about 25,000 feet. While the research work which has been done on them was undertaken chiefly for economic reasons, it can be said that no great thicknesses of sediments, fossiliferous or otherwise, have been studied more fully than have these which are considered to be of pre-Cambrian age.

The origin of the gold is such an important factor, both from the economic and the scientific point of view, that the sediments have had to be studied with unusual care. Later workers on these ore deposits appear to be pretty well agreed that the gold was laid down with the conglomerate, forming a placer, but has since been dissolved and re-precipitated. Were it not for the economic importance of these rocks comparatively little would ever have been known about them. The character and origin of the remarkable beds of conglomerate and other features which belong to pure science would never have been determined. The same may be said of many other mining areas.

Another striking example of what the mineral industry has done and is doing to assist in bringing about a knowledge of the geological structure of remote and isolated regions is that of the petroleum geologist, who is often more or less maligned. A knowledge has been obtained of the fossiliferous rocks in remote parts of South America and in other parts of the world through the work of petroleum geologists within a comparatively few years that otherwise would have taken decades. The correctness of the conclusions of these geologists concerning the age and structural relations of these rocks is usually proved or disproved in a short time.

It will be acknowledged that Geological Surveys, supported by governments, have done more for the methodical study and mapping of wide areas than has any other agency, and there would be few, if any, of these surveys were it not that they are supported primarily with the object of describing and developing mineral resources. Even the greatest of Geological Surveys, that of the United States, owes its origin chiefly to economic reasons. The late S. F. Emmons has said that when the first Geological Surveys were established in the west the people had little conception of the advantages and uses of such an organization and a campaign of education of the popular mind was necessary in order to demonstrate its practical value. For ten or twelve years such a demonstration was carried on by the Hayden, King, Wheeler and Powell Surveys, or geological explorations, as they might more properly have been denominated. Most of them appealed to the popular, as well as to the scientific, imagination by their brilliant discoveries of such natural wonders as the geysers of the Yellowstone, the canyons of the Colorado, and the laccolites of the Henry Mountains. The Geological Exploration of the Fortieth Parallel, which alone planned to make a geological map of a definite and limited area, secured its appropriation from Congress on the explicitly economic ground that it was necessary for determining the character of the mineral resources of the mountainous regions to be made accessible by the recently authorized Transcontinental railroads. In furtherance of the plan of popular education, Mr. King, its organizer and chief, pushed to immediate publication the economic results of the work, the study of actually developed mines including the Comstock lode, set forth in a volume on Mining Industry which appeared in 1870, seven years before those embodying the more abstract scientific results which had to wait the completion of the researches of specialists. The final realization of the ultimate object that the geologists of the Fortieth Parallel Exploration had in their minds during the ten years spent on that work came much earlier than had been anticipated, when in 1879 all existing geological explorations were consolidated into a permanent Geological Sur-

vey, which was organized as a bureau of the Interior Department; and there is little doubt that the practical demonstration of the utility of such work furnished by the Mining Industry volume had much effect in rendering Congress favorable to the new organization.

A Canadian may be permitted to say that the geologists of the United States occupy a pre-eminent place in the world, and that the Geological Survey has had much to do in assisting them to achieve this premier position.

From what has been said concerning the geological work that has been done in the mining areas mentioned it seems difficult to draw the line between so-called economic geology and the pure science. Because a geologist is working out the age and structural relations of the rocks in a mining area, primarily with the object of aiding the mineral industry, is there any reason to believe that he has less love for the science or is less enthusiastic in its promotion than is one who spends his time studying the rocks in areas which are of no economic importance? Moreover, does not a man who works in an area where extensive mining operations are being carried on obtain more facilities for arriving at a proper understanding of the problems than he would if no mining was in progress? Undoubtedly some men find it more pleasant to work in areas that are free from economic problems. One of the older writers has said, "There may not always be found a geologist willing to turn away from his delightful studies to avert the ruin which can only fall on those who disregard the plainest truths of geology."

Cosmogony and geology both have had what may be called theological affiliations. While, on the one hand, the progress of geology was retarded by theological prejudices, on the other, theological controversies tended to popularize the science. The popularity of works such as those of Hugh Miller and Sir J. W. Dawson depend to a large extent on the fact that they deal with geology in its relation to theology. There was scarcely a Scotchman in the generation which has just passed away that had not heard of Hugh Miller and read some of his works. Even to this day a geological visitor to lonely Highland glens is likely to meet with a workman or peasant who is surprisingly well read in certain features of geology. Probably one criticism that could be made of the geologists of the present day is that they do not do nearly so much to popularize their science as did their predecessors in the last generation. As an illustration of the popularity of some of these older authors it may be said that even within the last twenty-five years sets of their writings have been found among the books offered to the Christmas trade.

Among those who have greatly helped in the advancement of the science there have been few who were men of independent means, such as Hutton and Lyell, and geology at the present time could not make much progress did it not depend chiefly on financial assistance from governments and those who are interested in the mineral industry. It is true, as has been said, that geology more largely than any other science is regarded as a governmental function.

That applied geology is not a new subject in this country is shown by the fact that in the first annual volume of the proceedings of the American Association for the Advancement of Science reference is made to the "Society for the Development of the Mineral Resources of the United States," which proclaimed that "With unabated admiration for all that part of geology which is strictly scientific we devote ourselves particularly to its æconomical department." From the quotation it will be seen that the objects of that early society were not unlike those of the Society of Economic Geologists organized a couple of years ago.

Since all economic work of importance in geology requires a thorough training in the principles of the science, and since there is such a variety in this work, it does not seem that the training of the man who expects to labor in mining and mineral areas should be different from that of the man who is to pursue the pure science.

In conclusion, if the science is under such a great debt to the mineral industry for facilities and opportunities provided, why should there be a tendency to ostracize the geologist who does work that has an economic value? Why should it be necessary to proclaim the legitimacy of applied geology? Let the man be encouraged who desires "to carry on economic research in a scientific way." Did not Edward Forbes, in the words he used long ago, express the correct attitude towards applied sci-

ence? "When science, provided she be mindful of her honor, and make no sacrifices of her love of truth, serves as the handmaiden of even the humblest of arts, her dignity gains in lustre, and her familiarity breeds respect."

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THE SCHOOLMASTER AND THE TEACHER[1]

IT is very much to be feared that what I have here to say will appear so trite as to be little better than thrashing over of old straw. I am quite sure that much of it has been said (and perhaps better said) many times before. But no student of the problem of science teaching can observe the changes that are taking place in the system of scientific education, and particularly in the character of the results of the teaching of chemistry in our colleges and universities, without feeling that we still have much to learn about how to teach successfully. We cannot regard the subject as being closed. No one has yet discovered the grand secret in its entirety and no teacher of any branch of chemistry, who is both intelligent and honest, can be wholly satisfied with what he observes is going on in the minds of his students, as a result of his contact with them. This is my only excuse for reviving this ancient subject and for adding another bit to the already formidable accumulation of treatises directed toward the solution of such important questions as these.

I do not propose to offer to this section the affront of trying to tell you how to teach chemistry. Many of you have had far more experience in this field than I. Indeed, I frankly confess that I am not an authority on the art of teaching. If I were I should simply write out the recipe, and have it mimeographed and distributed; this you would then properly consign to the waste basket, for each one of you would know of a much better way than the one I would give you. There is no magic word or phrase that is the "open sesame" to the door of success in teaching. Each of us possesses, in some degree, the ability to instruct. But the part that one does well another does poorly. What both fail to attain another will accomplish, and so on. Were it not for this we should not be here to-day, gathered for a mutual exchange of ideas.

For this reason I shall presume upon your time and good nature long enough to say a few things about the general question and about some of the results of my own observations. These may be taken for just what you consider they are worth—no more (of course) and no less (I hope).

Much has been said and written about the necessary qualifications of a teacher. And, after all is said and done, we might finish by saying that the successful teacher of chemistry is one who can teach chemistry. Teaching is not coaxing or coddling, cramming or browbeating. Neither is it the administration of sugar-coated knowledge pills, to those who would cultivate the luxury of sleeping sickness. Our job is so to conduct our classes that our students shall be glad to be in them and that they shall leave them with regret, but carrying with them not only the fullest possible knowledge of the subject but also a deep and abiding respect and love for their chosen science and a boundless enthusiasm for its possibilities. Not an easy job, this, by any means,—as we all know. On the contrary it is one that requires large experience and training and large understanding of human possibilities, human ambitions and human habits of thought.

With this introduction and apology may I begin at what may seem to be the wrong end of the business by saying that the very first requisite for the teaching of chemistry is correct personality on the part of the teacher. This is not a prime necessity for successful work, for example, in chemical research or chemical industry. The researcher *must* have thorough training in fundamentals, thorough knowledge of chemical literature and a logical mind, capable of clear and systematic organization and prosecution of his work and, having these, he may be eminently successful even though his personality may be such as to cause him to be thoroughly disliked by all of his associates. Pray do not understand that I charge the industrial research chemists with such a

[1] Paper read at the Pittsburgh meeting of the American Chemical Society, September, 1922.

lack of human characteristics. On the contrary, I know and admire many of these gentlemen who I wish to heaven were now in the teaching profession, because I know that their influence over our young students would be of enormous benefit to the progress of the science. I simply state that the research chemist *may* do without personality, though the teacher cannot.

Much has been said, one way or another, about the correct method for developing the subject of chemistry in the class room and student laboratory and much more will be said. We want our students to understand that chemistry didn't simply happen but that as we have the science to-day it is the product of hard and careful work and of an infinite expenditure of human brain power, on the part of those who, in the past and present, have been able to search out and to reason, and who have known the virtues of cold, invincible scientific logic. How to impress this most satisfactorily is not an easy question to answer. I do not know just how to do it. I have heard discussed with much feeling the burning issue as to whether or not the beginner should be allowed to see (and use) a chemical formula before he has been taught how and why the formula was evolved. I do not know which is the right side of this question, although I know a great many other people who do know—both ways. What I know is that we may argue this question until doomsday but by neither the one system nor the other can the teacher ever inspire the student with either respect or love for chemical science except as this may be founded upon the prerequisite of respect and love for the teacher himself and that no one need expect ever to attain success in the work of science unless he has respect and love for that science. The student must believe what the professor is telling him and this belief must be so deep-seated that he is inspired thereby with enthusiasm to know more of that which forms the chosen life work of his teacher. In the very nature of things, such a working belief must have its origin, in the largest degree, in an interest springing from the personality of the teacher himself.

It may be that this is only "kindergarten stuff"—or it may not be. I am not a psychologist, though an observer of psychology as are we all. As I recall my own teachers in the grades, high school, college and university, I am more than ever convinced that it was only in the classes where my teacher was a respected and admired leader that I learned much that was of any lasting benefit to me. It may be that this was my fault. It might well be argued that it is always the business of the student to exert himself to the point of learning that for which he has entered the class, without regard to his personal feeling toward the instructor. However we are not so much concerned with an effort to place the blame for failures in teaching as we are to discover the failures themselves and to avoid them wherever possible.

The business of the teacher of chemistry is not simply that of handing over to the student, through an approved and standardized system of pedagogy, a set of facts and elaborately developed theories, with the invitation to take it or leave it. How often have we seen this tried —how often have we even had it tried upon us! "Here is chemistry," says the instructor, in effect, to us. "I am paid for giving you the opportunity to get it. If you want it, take it, if not, get out." The student can find no fault with this. The procedure is obviously just to him and the problem is thus placed squarely before him for his own solution. And yet is it not true that the result of such teaching is generally little better than a dull sort of forced interest,—at best a determination on the part of the student to "get by" in the course or to acquire a smattering of the subject, sufficient to do something in the way of earning a livelihood after graduation?

It may be that a teacher after this fashion earns his salary, in a technical sense, for he has gone through the motions of teaching a given number of classes of the correct number of students, properly and each day according to schedule. But I think that we all concede that the real work of the teacher of chemistry is something quite different from this. To him is given one of the most important trusts of science: that of helping to equip his students with that which should enable them to do useful and efficient work in a field that calls for the highest kind of enthusiasm and energy. Dullness and passive acceptance of a teacher's

dictum has never and can never equip a young man or woman for work of this character.

The teacher of chemistry must himself be an original investigator. It is not essential that he shall have attained brilliant success in this field. It is only the exceptional few who are capable of that and most of us must be content with adding in a more humble fashion to the sum of scientific knowledge. But a professor of chemistry must do more than "profess." He is either going to leave with his students the impression that chemistry is now practically a finished story, with little more to be written, or else he must show them that it is a living science, the delving into which is a fascinating and necessary part of the activities of the devotee of chemistry. The student is not long in discovering that the first impression is erroneous, upon which he loses all confidence in his instructor that he might have felt. And the teacher can not consistently teach the second attitude unless he is himself doing something toward uncovering the hidden things of his science. Precept and practice must go together in this case or else the precept will become merely a dead formula.

The student of chemistry must be taught that chemistry, as all science, is the truth of nature and that as such it is to be respected. We may, and do, change our minds occasionally about whether a particular interpretation is the truth but we never doubt that science itself is truth and that before it all sham and pretense and hypocrisy must give way. This is the reflection that makes us respect science above all things and if we fail to bring the student to a full realization of it we have failed in our mission as teachers. Nothing else can supply the want of it and it is because of this want, in greater or less degree, that our colleges turn out too many men whose highest ideals of scientific work contemplate juggling with scientific knowledge and trifling with scientific truth in such a way as to win out in conflicts with other folk of similar character, whose wits are pitted against them. This (to use a bit of common slang) is why we have our shyster chemists as well as our shyster lawyers. The only way by which a teacher can instill a proper respect for chemistry into the life of the student is by showing in all of their mutual contact that he himself feels it intensely.

Carlyle tells us, in his vigorous and striking way, that the upheaval involved in the French revolution swept away all sham,—that imposture was burnt up by it. Which was, no doubt, true in the sense in which he wrote. But how long will it be before we shall have an end of sham and imposture in chemistry, before our fakers of science shall have been cast into the outer darkness of contempt? Too long, we are led to fear, when we contemplate the attitude of a certain fraction of our yearly crop of graduates, whose outlook upon life and whose sense of responsibility toward the cause of science has suffered through too much contact with schoolmasters of science and too little companionship of teachers.

One of the most difficult of tasks imposed upon the teacher of chemistry and other science is that of creating in the minds of his students the proper attitude toward questions of religious belief as they are related to scientific study. I have heard the "conflict" between science and religion discussed *ad nauseam* for so many years that it has become almost a positive discomfort to me to attend church services, especially in a college town where so much attention is given by religious teachers to students of science who are trying to straighten out their mental troubles along these lines. And trying vainly, it seems to me, in most cases, largely because they have not the proper help from the source upon which they have the right to place the most reliance,—that of the teachers of science in the college. What usually happens is that the college teacher goes right ahead with the thing he is paid for doing. That is, he teaches his science and nearly or entirely ignores religious questions because he knows (whether he proclaims it publicly or not) that the study of science is the search for truth by absolutely the only method that can ever discover truth,—that of experimentation and logical reasoning,—but that our religious leaders will not and can not admit this without giving up a great mass of what they mistakenly consider as essential to religion.

The student is thus left entirely to his religious leaders for instruction in matters that

are of great and vital concern to him. The religious leader is too often nearly or entirely untrained in matters of science and in scientific methods of thought and (still more unfortunately) he is frequently unaware of his own limitations in this respect. It, therefore, happens that there come from our pulpits and our Sunday School classrooms great quantities of instruction designed to quiet the "doubts" of students of science, the religious instructor making use of a patter of scientific words and phrases, abused and garbled, with good intentions, but with lack of understanding, so that the student is more or less self-hypnotized into a temporary state of mental quietude concerning these matters.

If affairs were as they should be, our teachers of science would be perfectly correct in confining their efforts to the teaching of their own special phase of science. For true religion is a matter of the soul and it has little or nothing to do with any science, unless it be that of psychology. But *what passes for religion* in the minds of many (if not most) people is of very vital concern to the scientist because it contains a mass of dogma which can not be reconciled with the truths of science as we accept them and which is not susceptible to test by any method. And I maintain that no teacher of chemistry, biology, physics or any other science can consider his duty to his students as fulfilled if he allows them to cultivate one attitude and acquire one set of ideas in the classroom and another, incompatible with the first, in the pew. They will ultimately either come to a point of forsaking their religious beliefs entirely or to that of passive acquiescence in something which they can not, really and truly, believe. The latter is a state of mind all too common to-day and it is not a healthy state for either true science or true religion.

I have not meant simply to inflict a preachment upon you,—many of whom know far better than I of the things of which I have briefly spoken. But it has seemed to me desirable once again to direct our thoughts toward the problems of teaching,—not as they relate to the preparation of the student, the system of teaching or the arrangement of content of courses —important as all of these are,—but as they go back to the teacher himself, for upon him as a man must finally rest the responsibility for failure, as well as the credit for success. The truly successful teacher is the one who constantly studies himself as he watches the effect of his efforts upon the minds of his students and who continually tries to correct his failures and to strengthen his successes, putting himself in the place of the student, always. We have all had our schoolmasters and our teachers. We have but to project ourselves backward through the years to see examples of what we would wish to be, as well as of what we hope never to be.

E. G. MAHIN

PURDUE UNIVERSITY

BERNHARD EDUARD FERNOW

DR. BERNHARD EDUARD FERNOW, author, pioneer educator, organizer of the forestry movement, and the first United States Forester, after a long illness died at Toronto on February 6 at the age of 72.

Dr. Fernow was a native of Germany and studied under the famous Heyer and other noted foresters. He first came to this country in 1876 and soon took an active part in the forestry movement of New York State, where he formulated legislation establishing the Forest Reserve in the Adirondacks. From 1885 to 1898 he was editor of the *Proceedings* of the Forestry Association. Sponsored by this Association was the greatest piece of forest legislation so far adopted in our country—the law of 1891 authorizing the President of the United States to establish National Forest Reserves. This act led to the creation of the present National Forests.

In 1886 Dr. Fernow's great work for the nation really began, when he accepted the position of organizer and director of the forestry work of the government for the Department of Agriculture, a position which he occupied until 1898.

During twelve years at Washington Dr. Fernow kept in close touch with the forestry work in the various states and there was little of state forest legislation passed during this time in which his opinion was not consulted. He secured the cooperation of many prominent men of science and the numerous bulletins and

circulars including monographs on white pine, the southern timber pines; results of tests and studies in timber physics, the first complete discussion of the metal railway tie as a possible substitute; studies on timber impregnation and other subjects all of immediate value in wood utilization are evidences to-day of the painstaking work of the guiding spirit which directed them and edited their results for publication.

Throughout the twelve years in the Department of Agriculture Dr. Fernow never ceased to write articles and addresses. In these years the larger part of two hundred articles and addresses, over twenty circulars, and over thirty bulletins and reports were prepared and edited.

In 1898 Dr. Fernow was called to Cornell to organize the first forestry school in the new world. Here he inaugurated the beginnings of professional education. The school grew rapidly, but the forest operations in the college forest in the Adirondacks met with opposition of wealthy camp owners. In 1903 the Governor vetoed the appropriations of the forestry school and this resulted in its discontinuance. After leaving Cornell he worked for four years as consulting forester. During these four years he continued the *Forestry Quarterly;* delivered lectures at Yale University, and started the forest school at Pennsylvania State College. In 1907 Dr. Fernow accepted an invitation to Toronto University and organized the first forest school in the Dominion. At the time of his death he was professor emeritus of that institution.

His well-known "History of Forestry" is a masterpiece of its kind, covering the subject for both the Old and New World.

Three years ago when Dr. Fernow retired from active teaching there was published in *American Forestry* a tribute by Raphael Zon to the father of forestry in the new world. To-day the words assume an added significance. "While the period which Dr. Fernow typifies is rapidly becoming history, his teachings and his contributions have the equality of permanence. They have been always a source of inspiration and guidance to the pioneers of forestry; they will be infinitely more so to the actual managers of our forest lands as soon as real woods forestry comes into general practice. As with any great teacher, it is not the kind of theory that he happens to advocate that really counts, but the ability to teach how to think in his particular field. Theories come and go, but the ability to orient oneself in the details of complex problems is a lasting asset; he who teaches to meet ever-changing problems, not by a ready-made theory or hypothesis, but by a critical attitude and ability to discern between the essential and non-essential, is building on a solid foundation. With him forestry was not merely theory but a movement ever changing as life itself, and for him problems became soluble not in ready-made formulas, but in the forces, economic and natural, that are at work."

X.

GEORGE LEFEVRE

George Lefevre, professor of zoology in the University of Missouri and chairman of the department, died on January 24, after a brief illness with pneumonia. The foregoing announcement marks the passing of one who was probably the best loved man in the American Society of Zoologists, a man whose brilliant intellectual endowment and gifted nature marked him as a unique personality. Born of old American stock and inheriting his name from a Huguenot ancestor who immigrated at an early date, he was the son of a prominent Presbyterian clergyman who raised his children on good English, the Classics and the Shorter Catechism, and who read his original Greek and Hebrew almost to the day of his death.

After Professor Lefevre's graduation from a famous boys' school in Baltimore, the family spent a year in European travel; and although he was too young to profit scientifically by the experience, this European sojourn became an invaluable part of his cultural education. During his earlier boyhood the family spent long vacations in the country near Baltimore, where he acquired an interest in natural history and became an ardent amateur naturalist. It is, therefore, not surprising that he should have been attracted to zoology after his entrance to the Johns Hopkins University. Here he received a fundamental scientific training under the influence of Remsen, Rowland, Martin,

Brooks and others of that generation. Throughout his life he remembered with pride that as an undergraduate he studied under such influences. His graduate work in zoology was pursued in the same institution and after an unusually thorough training extending from 1891 to 1896 he received the doctor's degree. After a further apprenticeship as an assistant at the Hopkins, he taught in Atlanta, Georgia, in the year 1898-99; and in the fall of 1899, was appointed professor of zoology in the University of Missouri, which position he held until his death. At the Hopkins he was commonly regarded as one of the most brilliant men who had ever been enrolled in zoology. His ten years as undergraduate and graduate he sometimes regretted because of the continuity of associations. But they gave him a foundation that few men obtain and one that was in evidence throughout his life.

From the beginning he occupied a prominent place upon the faculty of the University of Missouri. Probably no man not in one of the major administrative positions exercised greater influence, and personally there was none who equalled him. He was always loaded with a burden of committee work of the most diverse sort from which he was never released, because his idealism, good judgment, courtesy, and unquenchable humor rendered his services indispensable. In his own department his personality was unfailing and the tradition of its *esprit de corps* is known throughout the country. The present biological building with its admirable arrangement and equipment is his creation more than that of any other man, for he enjoyed the confidence alike of architect and university administration and his leadership in the team-work of his department yielded a remarkable return for the investment. But more than this his name is written in the hearts of students and colleagues through his ideals as a scholar and a man and through the charm of his personality. Among his associates on the faculty he was universally recognized as a man of the finest intellectual quality. His keenness of wit, his gift in conversation, and his social graciousness made him a marked man, whose friendship was prized and who was admired by all who understood the spirit within him.

The Lefevre laugh will be remembered by every one who knew him; also his stories, for he possessed a gift of mimicry along with his sense of humor. One of his friends who knew him best once dedicated the following lines to his brave spirit of laughter that often masked an unsuspected burden:

TO THE MAN WHO LAUGHS

A health to my friend
With spirit blythe!
From Cavaliers of old
Who laughed at fate,
Perchance came down
That spirit which makes him bold.

Let Roundheads sigh
Sit sourly by
And scorn the fleeting show
But men like you
They dare and do
And jest 'neath stinging blow.

Who hath seen his dead,
But with spirit uncrushed
Hath faced his life anew
With a smile on lip,
Though the heart went white,
And won to happiness new.

Who when death comes,
Though others quail
And silent its bitterness quaff,
Shall laugh at death—
So all may know
What glory it is to laugh.

In the matter of publications, what he did was done with the finish of a master workman, and those of us who were associated with him know that his scientific mind was eternally active. Studies upon the morphology and embryology of the Tunicata constituted the work of his student days. A paper upon "Artificial parthenogenesis in Thalassema" (1907) is representative of his interests from 1902 to 1906. An extended investigation of the "Artificial propagation of fresh-water mussels," in collaboration with the writer of this article, occupied some half dozen years before it was finally published in 1912; while lesser papers in cytology by himself and his students marked his dearest interest. Cytology and genetics absorbed his attention in recent years. Under the auspices of the agricultural experiment station at the University of Missouri he carried

out an investigation of the inheritance of certain coat colors in poultry, the last paper of which was on his desk completed and ready for mailing at the time of his death.

In recent years his physical well-being was seriously impaired, and no doubt his untimely end was the indirect result of a long-standing disability. When a graduate student he underwent a serious operation supposedly for appendicitis. What was actually done was to drain an abscess and save his life. The abnormal conditions thus produced followed him throughout the remainder of his life. This circumstance, and the tragic death of his first wife in 1900, the year following their marriage, laid upon him a burden that many men could not have endured. But he was outwardly cheerful and uncomplaining. In 1914 increasing difficulties rendered an exploratory operation imperative. Gall stones and his supposedly absent appendix were then removed. A year for recovery and a few years of comparative comfort, then further intestinal disorders, more comfort when he was assured in 1921 that it was nothing more serious than adhesions of the old wounds, but an obvious frailness of body that alarmed his friends, until in recent months he seemed fit to succumb to any serious disturbance, although there was no flagging of spirit.

On Monday, January 15, he presided at a departmental meeting in his inimitable fashion, on Wednesday he conducted his seminary and seemed at his best, a week in bed and he died on the evening of the Wednesday following, at the time for the customary assemblage of students at his home. Would that it could be given to all of us to go out of life like that, having fought so good a fight and having preserved such spirit to the end.

Professor Lefevre leaves a wife, having married Julia Faris in 1914. A son, who bears his name, already shows many of the traits that so endeared the father to his associates. The loss is irreparable. But the present George Lefevre will never lack devoted friends. His father was a scholar—and more than that, he was, to those of us who loved him best, the finest gentleman we ever knew.

W. C. CURTIS

UNIVERSITY OF MISSOURI,
FEBRUARY 1, 1923

SCIENTIFIC EVENTS

THE NEW ELEMENT HAFNIUM

DRS. COSTER and G. HEVESEY write from the laboratory of theoretical physics of the University of Copenhagen to *Nature* on January 21 as follows:

In a former letter to *Nature* (January 20) we announced the discovery of a new element with atomic number 72, for which the name hafnium was proposed. Evidence was given that this element is a homologue of zirconium in accordance with theoretical expectations (Bohr, "Theory of Spectra and Atomic Constitution," p. 114, Camb. Univ. Press, 1922). Continued experiments enable us to complete the statements in the former letter. By the addition of a known quantity of tantalum (73) to our samples, and by a comparison of the intensity of the Ta-lines with the Hf-lines, a closer estimate of the amount of hafnium present has been obtained. We have investigated a great number of zirconium minerals from different parts of the world. They all contained between five and ten per cent. of hafnium. In samples of commercial zirconium oxide investigated, we have found the new element, amounting in one case to as much as five per cent. Starting from the latter substance, by means of a chemical method which is also adapted to separate zirconium from the other tetravalent elements, we have been able to obtain several grams of a preparation in which the presence of about fifty per cent. of hafnium could be established. Conversely, we have succeeded in preparing zirconium in which no hafnium lines could be observed. Further particulars about the method of preparation and provisional determination of the atomic weight will be published shortly in the communications of the Copenhagen Academy.

In an editorial note *Nature* says:

Since the publication of the letter "On the Missing Element of Atomic Number 72," by Dr. Coster and Professor Hevesey, in *Nature* of January 20, p. 79, it has been announced that Dr. Alexander Scott detected and separated the oxide several years ago. It appears that while examining in 1913 a specimen of titaniferous iron sand (75 per cent. Fe_3O_4, 25 per cent. TiO_2) from near Maketu in the North Island, New Zealand, Dr. Scott noticed that in the titanium dioxide separated in the ordinary methods of analysis there was always a small residue which resisted all attempts to get it into solution, either as sulfate, chloride or nitrate. Neither would it go into solution after prolonged fusion with caustic soda. No trace of the many "rare earths" was found

in the sand. The insoluble residue remaining after repeated and alternated fusions with sodium bisulfate and caustic soda was labeled "New Oxide" in 1918. Its properties and mode of occurrence indicated that it was an oxide of the titanium-zirconium group, and that it was the oxide of the missing element, of which the atomic number is 72. Some of its properties showed a resemblance to tantalum, its next neighbor, with the atomic number 73; but all traces of this element would be removed by the repeated fusions with caustic soda. As none of the ordinary salts were available for the purpose of determining the atomic weight, recourse was had to the double fluoride with potassium, which closely resembles those of titanium and zirconium. The rough determinations with material imperfectly purified for such a purpose indicated that the atomic weight of the element was between one and one half and two times that of zirconium (90.6). The oxide resulting from these determinations was of a cinnamon-brown color, not white as was expected. We understand that Dr. Scott wrote on January 28 to Drs. Coster and Hevesey offering to send them specimens of his separated material to compare with their own, and received a reply from them on Saturday night last (February 3) saying they would be very glad to do so. On Monday Dr. Scott sent to them practically all his purified material, and not only he, but also all scientific men, must await with keen interest the result of the searching examination by means of the powerful appliances in their hands for spectral analysis by X-rays. In view of the source of his oxide and its association with much titanium oxide, Dr. Scott has suggested, as Oceanus was one of the Titans, that "Oceanium" would be a suitable name for the element. This name would also recall that the sand came from Oceania, of which New Zealand is one of the component parts.

GEODETIC AND TIDAL SURVEYS

A CONFERENCE was held in Ottawa on January 2, 3 and 4, at which officers of the United States service discussed with Canadian officials problems common to the two countries. The visitors were Dr. William Bowie, chief of the Division of Geodesy of the United States Coast and Geodetic Survey, who conferred on geodetic work with Dr. E. Deville, director general of surveys, and Mr. Noel Ogilvie, director of the Geodetic Survey of Canada, and Mr. G. T. Rude, chief of the Division of Tides and Currents, who met Dr. Bell Dawson, superintendent of the Tides and Current Surveys of Canada, and discussed tidal data.

The cooperative geodetic plan includes primary or precise triangulation along the international boundary from Lake Superior to the Pacific coast, and extension of triangulation in Idaho, Oregon and Washington to the Canadian boundary. On the Pacific coast similar cooperative work is being carried on from northern Washington through British Columbia to the Yukon territory and Alaska. The plan also includes several lines of precise leveling for strengthening the precise level nets of both countries.

The triangulation and precise leveling will be available to both countries for all classes of work needing precise control. The result will be coordination in the surveys of the two countries, and the geographical positions of boundary monuments will be the same on the maps of each. Accurate maps are possible only after the precise establishment of geodetic control points, and on accurate maps the development and prosperity of any country largely depend. Accurate maps have also an important influence in promoting cordial international relations.

Referring in one of his public addresses in Ottawa to cooperative geodetic work, Dr. Bowie stated that, as far as triangulation and precise leveling were concerned, there was one geographical unit for Canada, the United States and Mexico. He added that North America was the only continent that could boast of this uniformity, and that Europe for years had been struggling, so far unsuccessfully, to obtain the same result. Geodetic cooperation between Canada and the United States was most conspicuous and most happy.

Mr. Rude spoke of the importance of accurate charts and of a thorough investigation of facts relating to tides and currents. He referred also to the cooperation that existed between Great Britain, Canada and the United States in regard to the interchange of such knowledge.

COLLOID CHEMISTRY

WITH the assistance of prominent specialists the world over, I am preparing a comprehensive book on Colloid Chemistry, Theoretical

and Applied. The extensive and international character of the book is evidenced by the subjoined list of some of those who have already promised contributions:

United States: E. G. Acheson, W. D. Bancroft, Carl Barus, M. H. Fischer, W. D. Harkins, H. N. Holmes, G. A. Hulett, D. D. Jackson, G. F. Kunz, R. S. Lillie, D. T. MacDougal, S. E. Sheppard, A. Silverman, E. B. Spear, E. W. Washburn, A. W. Thomas, H. A. Gardner. England: E. F. Armstrong, Henry Bassett, W. M. Bayliss, E. F. Burton, W. B. Hardy, F. G. Donnan, F. E. Lloyd, A. E. Dunstan. Germany: H. Bechhold, G. Bredig, A. Fodor, H. Handovsky, A. Lottermoser, Lüppo-Cramer, R. Höber, W. Ostwald, H. Plauson, E. Stiasny, G. Tammann, H. Schade. Austria: C. Doelter, W. Pauli. Jugoslavia: M. Samec. Sweden: Sven Oden. Holland: H. R. Kruyt. Mexico: A. L. Herrera.

Many unusual experimental facts and practical applications of colloid chemical principles are unpublished, and the object of this letter is to ask any one in any field of science or experience who may have information of interest to send me a brief statement for inclusion in the book.

Contributions may consist of a paragraph, a page, or several pages, and will (unless contrary request is made) be duly acknowledged. If possible they should be submitted in English and duplicate copies will be appreciated. Authors should state their full names and titles.

The editors of scientific, technical and cultural publications in all countries are asked to disseminate this appeal.

JEROME ALEXANDER

50 EAST FORTY-FIRST STREET,
NEW YORK CITY

DR. PAUL WAGNER

ON the seventh of March, the noted German agricultural chemist and investigator, Dr. Paul Wagner of Darmstadt, will complete his eightieth year, at which time his numerous friends and pupils in Germany will hold a celebration at Darmstadt in his honor.

Fifty years ago, Dr. Wagner became director of the Experiment Station at Darmstadt, which had just been founded, and has since won for this institution a world renown, through his investigations on plant foods. He certainly deserves to receive great commendation for having, with the help of his own method of pot experiments, substantially extended and firmly established the foundation for the use of commercial fertilizers.

He was the first to recognize and correctly estimate the fertilizing effect of the Thomas phosphate or basic slag. By a steady improvement in the methods of fertilizer experiments in the field, he succeeded in making of these field experiments a practical means of exact investigation.

Dr. Wagner, furthermore, has clearly shown the results of his investigations in the vegetation house, field and laboratory to the practical farmer, both in articles which are easily understood and in inspiring lectures; and in this way he has contributed in an enormous degree toward the proper use of commercial fertilizers in agriculture.

Here in the United States, many of Dr. Wagner's articles are known, having been translated or summarized by numerous writers to the great advantage of American agriculture.

H. A. H.

SIGMA XI LECTURES

THE following public lectures were given before the Iota Chapter of the Society of Sigma Xi, University of Kansas:

Dr. Henry B. Ward, professor of zoology, University of Illinois: January 10, "The struggle of man with the life of the wilderness in North America," and "The factors which control and direct the migration of the Pacific salmon."

Dr. A. Sommerfeld, professor of mathematical physics, University of Munich, at present holding the Karl Schurz memorial professorship at the University of Wisconsin: Jan. 20, "Atomic structure and periodic system of elements."

Officers of Iota Chapter are:

President, F. B. Dains, professor of chemistry.

Vice-president, W. S. Hunter, professor of psychology.

Secretary, Guy W. Smith, assistant professor of mathematics.

Treasurer, H. E. Jordan, assistant professor of disseminate this appeal.

In a visit to the University of Oklahoma Dr. Henry B. Ward, national president of Sigma Xi, addressed the local Sigma Xi Club on the evening of January 11 on "The struggle of man with the life of the wilderness in

North America." Dr. Ward also addressed the general student body on the morning of January 12, giving an illustrated lecture on "The factors which control and direct the migration of the Pacific salmon.". He came to the University as guest of the local Sigma Xi Club.

GRANTS FOR RESEARCH MADE BY THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

THE Committee on Grants held its annual meeting in New York on December 31, 1922, and distributed four thousand dollars which was assigned by the council of the association for the year. Two members of the committee, Messrs. Moulton and Lamb, having retired at the end of the year 1922, the present organization of the committee is: Robert M. Yerkes, *chairman;* William D. Harkins, *secretary;* E. G. Conklin, C. Judson Herrick, George T. Moore, E. L. Nichols, Frank Schlesinger and David White. The committee elected a secretary for a term of four years.

The grants made for the year 1923 are listed below:

ASTRONOMY

No. 102: W. W. Campbell, Mt. Hamilton, Cal., $225 for assistance in constructing an interferometer for use in measuring double stars.

No. 103: Bernhard H. Dawson, LaPlata, Argentina, $300 for assistance in preparing catalog of 7,800 southern stars.

BOTANY

No. 104: S. M. Zeller, Corvallis, Oregon, $250 for aid in study of Humenogastrales of North America.

No. 105: John T. Buchholz, Fayetteville, Ark., $125 for aid in continuing work in quantitative studies of pollen tube growth, etc.

No. 106: Albert R. Sweetser, Eugene, Ore., $125 for aid in work on flora of the Kerby Quadrangle.

CHEMISTRY

No. 107: A. W. Rowe, Evans Memorial, Boston, Mass., $300 for providing apparatus for studying rate of oxidation of ether.

No. 108: S. A. Mahood, Tulane University, New Orleans, La., $200 for assistance in study of cellulose chemistry.

No. 109: H. I. Schlesinger, University of Chicago, $300 for part payment of Hilger quartz spectrograph.

GEOLOGY

No. 110: V. C. Allison, Bureau of Mines, Pittsburgh, Pa., $150 for assistance in study of rate of growth of stalagmites.

No. 111: Ferdinand Canu, Versailles, France, in collaboration with R. S. Bassler, U. S. National Museum, Washington, D. C., $250 for aid in continuation of study of recent Bryozoa in Gulf of Mexico, etc.

No. 112: Taisia Stadnickenko, Poughkeepsie, New York, $200 to assist in micro-chemical study of oils, shales and coal.

MEDICINE

No. 113: H. V. Atkinson, University of Texas, Galveston, Texas, $200 to continue study of changes of blood under influence of drugs.

No. 114: M. S. Fleisher, St. Louis School of Medicine, St. Louis, Mo., $200 for expenses in studying yeast-like organisms in human beings.

No. 115: O. F. Kampmeier, University of Illinois Medical School, Chicago, Ill., $100 for assistance in completing monograph on morphology of lymphatic systems of vertebrates.

PSYCHOLOGY, PHILOSOPHY, EDUCATION

No. 116: Kline and Carey, Skidmore College, Saratoga Springs, N. Y., and Duluth, Minn., $300 for aid in constructing measuring scale for freehand drawing.

No. 117: S. L. Pressey, Ohio State University, Columbus, O., $200 for assistance in X-O emotional tests.

PHYSICS

No. 118: L. Thompson, Kalamazoo College, Kalamazoo, Mich., $100 for constructing chronographs.

ZOOLOGY

No. 119: F. B. Hanson, Washington University, St. Louis, Mo., $250 for assistance in studying experimental modification of the germ plasm.

No. 120: Raymond Pearl, Johns Hopkins University, Baltimore, Md., $225 for partial payment of X-ray apparatus for studying *Drosophila.*

W. D. HARKINS,
Secretary

UNIVERSITY OF CHICAGO

SCIENTIFIC NOTES AND NEWS

DR. ARTHUR A. HAMERSCHLAG, former president of the Carnegie Institution of Technology, has been elected to the presidency of the Research Corporation. Its principal office is in New York City and Dr. Hamerschlag will give part of his time to its work, although he will retain his residence and office in Pittsburgh. The Research Corporation, it will be remembered, has been endowed by the gift of the

patents for electrical precipitation of Dr. F. G. Cottrell. The directors are: Elon H. Hooker, John J. Carty, T. Coleman DuPont, Frederick A. Goetze, Otto H. Kahn, Charles D. Walcott, Floyd N. Scott, Dr. Ellwood Hendrick, Howard Poillon.

Charles F. Rand, of New York, has been reelected chairman of the Engineering Foundation, which is directing a national program of industrial research, in cooperation with the National Research Council. Edward Dean Adams, of New York, was elected first vice chairman; Frank B. Jewett, president of the American Institute of Electrical Engineers, second vice chairman, and Joseph Struthers, treasurer. Dr. W. F. M. Goss, president of the Railway Car Manufacturers Association, was elected to the board to succeed George M. Basford, and Colonel Arthur S. Dwight, past president of the American Institute of Mining and Metallurgical Engineers, was named a director to succeed Edwin Ludlow.

Professor E. de Margerie, of the University of Strasbourg, during the month of February gave eight lectures on the work of French geologists and geographers at Cornell University. He is in this country as exchange professor and is dividing his time among the six American institutions that share in this exchange with France. They are: Harvard, the Massachusetts Institute of Technology, Yale, Columbia, Johns Hopkins and Cornell.

Dr. H. V. Arny, professor of chemistry at the College of Pharmacy, Columbia University, has been elected president of the American Pharmaceutical Association.

One of the most prominent Central American physicians, Dr. A. Quiñones Molina, was elected president of El Salvador, at the recent election.

Dr. G. H. Carpenter, professor of zoology at the Royal College of Science, Dublin, has been appointed keeper of the Manchester Museum.

Professor Louis C. Graton, of Harvard University, has been elected a director of the Society of Economic Geologists.

Dr. Richard R. Lyman, professor of engineering, was recently appointed regent of the University of Utah. Dr. Lyman is a graduate of the University of Michigan, and has been a member of the faculty of the University of Utah since he finished his graduate work at Cornell.

Lewis Radcliffe has resigned as assistant in charge of the division of fishery industries under the Bureau of Fisheries to take a position with the Tariff Commission.

Richard V. Ageton, of the Bureau of Mines, who has been doing examination work for the War Minerals Relief Commission, is acting as assistant chief mining engineer of the bureau.

Dr. W. Reid Blair has been appointed to the newly created position of assistant to the director of the New York Zoological Park. Dr. Blair will continue to act as park veterinarian.

Dr. P. D. Rodriguez Rivero has been appointed director general of health of Venezuela, to succeed Dr. L. G. Ghacin Itriago.

Dr. H. W. C. Vines, fellow of Christ's College, Cambridge, has been appointed to a Foulerton research studentship of the Royal Society, the duties being to conduct researches in medicine or the contributory sciences. Dr. Vines is carrying on his researches in the Cambridge Medical School.

With the arrival of Professor Zschokke has commenced an exchange of teachers between the University of Cambridge and Basel University. Professor Zschokke will give a course of sixteen lectures on the European fauna.

George S. Rice, the chief mining engineer of the Bureau of Mines, has been selected as the bureau's delegate to attend the mining exposition and conference which will be held in London from June 1 to June 14. Following the exposition he will visit other countries of Europe to continue his study of mining methods and the use of liquid oxygen.

Professor W. L. Badger, professor of chemical engineering at the University of Michigan, is taking a year's leave of absence beginning on February 1. He expects to continue his research work on evaporator design in Ann Arbor.

Captain Otto Sverdrup has left Trondhjem for the north, where he is to prepare, at the

request of the Norwegian government, a base for the examination into ice conditions in the Arctic Ocean, special regard being had to transport from Spitsbergen.

DR. E. V. COWDRY, of the Rockefeller Institute for Medical Research, delivered the seventh Harvey Society Lecture at the New York Academy of Medicine on February 24, on "The significance of the internal reticular apparatus of Golgi in cellular physiology."

THE Sigma Xi Club of Southern California held a special mid-winter meeting at the University of Southern California, Los Angeles, on the evening of February 10. Following a reception tendered by the Faculty Science Club there were addresses by Dr. James G. Needham, of Cornell University, and Dr. A. B. Stout, of the New York Botanical Garden, both of whom are spending the year at Pomona College.

DR. WILLIAM D. HARKINS, professor of physical chemistry at the University of Chicago, will give a course of three technical lectures on March 7, 8 and 9 at Carnegie Institute of Technology, Pittsburgh. He will discuss "Isotopes" and "Building and disintegration of atoms."

AT the Royal Institution, on February 13, Professor A. C. Pearson delivered the first of two lectures on "Greek civilization and to-day"; on February 15, Professor B. Melvill Jones began a course of two lectures on "Recent experiments in aerial surveying"; and on February 17, Sir Ernest Rutherford commenced a course of six lectures on "Atomic projectiles and their properties." The Friday evening discourse on February 16 was delivered by Professor A. V. Hill on "Muscular exercise"; and on February 23 by Professor A. S. Eddington on "The interior of a star."

M. JUSSERAND, the French ambassador in Washington, has stated that an offer to purchase the house in which Pasteur was born has been made by Mr. John D. Rockefeller, with a view to the establishment of a museum.

A MEMORIAL service for Dr. John A. Wyeth, distinguished surgeon and scholar, who died in May, 1922, was held on February 27, at the New York Polyclinic Medical School and Hospital. Dr. Wyeth founded the Polyclinic in 1881. In 1882 he established the first post-graduate medical school in the country. The program for the services included an invocation by the Reverend Dr. Charles H. Parkhurst, president of the board of trustees of the hospital; an address by Dr. Samuel W. Fairchild, and a tribute by Dr. Marion J. Verdery.

DR. JOHN WADDELL, associate professor of chemistry and librarian of the science department at Queen's University, Kingston, died recently at the age of sixty-four years.

THE Hon. Richard Clere Parsons, a well-known engineer, died in London on February 26, after a short illness, in his seventy-second year. Born in 1851, the third son of the third Earl of Rosse, the astronomer, he was elder brother of the Hon. Sir Charles Parsons, F.R.S., the great turbine engineer.

DR. FRITZ COHN, director of the Berlin Rechen-Institut and professor of theoretical astronomy in the university, died on December 14 at the age of fifty-seven years.

THE death is announced of Dr. A. Carruccio, professor of zoology and parasitology at the University of Rome, and of Dr. E. Cavazzani, professor of physiology at the University of Ferrara.

THE American Institute of Chemistry was organized at a meeting of local New York chemists on February 5. Dr. H. C. Byers, in charge of the department of chemistry at Cooper Union, and Dr. Lloyd Van Doren, a chemical patent lawyer, were elected, respectively, president and vice president. The secretary is Lloyd Lamborn, editor of *The Chemical Age*. The general purposes of the organization include the compilation of a code of ethics and the promotion of popular appreciation of chemical research and control in the industrial field.

THE thirty-ninth session of the American Association of Anatomists will be held in Chicago on March 28, 29 and 30, under the presidency of Dr. Clarence M. Jackson, professor of anatomy at the University of Minnesota Medical School.

IN connection with the announcement that

the trustees of the New York Academy of Medicine have acquired an option on a site for a new building at Sixtieth Street and Park Avenue, it is announced that on condition that the members of the academy acquire an appropriate site the Rockefeller Foundation will contribute $1,000,000 for the erection of a new building and that the Carnegie Foundation will contribute an endowment fund sufficient to care for the increased needs of its library and the enlarged educational activities that the institution is planning to carry on.

Consolidation of the State Agricultural Experiment Station at Geneva with the College of Agriculture at Cornell is the object of a bill to be introduced in the New York State Legislature in the near future. The bill is not opposed by the administrative body of either institution. The object of the consolidation is to coordinate the research work of the two so that duplication of effort may be eliminated.

We learn from the *Journal* of the American Medical Association that during the proceedings at Chicago, March 5, 6 and 7, of the annual congress of the council on health and public instruction of the American Medical Association, a meeting will be held on the afternoon of March 7 with the Public Health Service for the discussion of public health. At this meeting, over which Surgeon General H. S. Cumming has been asked to preside, the following program will be given: "Education of sanitarians and the future of public health in the United States," by Dr. H. S. Cumming, a report on the activities carried on by the Public Health Service since the conference of last March on the education of sanitarians, by Assistant Surgeon General W. F. Draper; "Recruiting and training of sanitarians," by Dr. C.-E. A. Winslow; "Steps already taken in standardization of public health training," by Dr. J. A. McLaughlin, U. S. Public Health Service, and "The course in public health and hygiene for medical students," by Dr. D. E. Edsal, of Harvard University. These addresses will be discussed by Dr. John Sundwall, of the University of Michigan, and by Dr. E. O. Jordan, of the University of Chicago. The closing address, "Education of the partly trained sanitarian now employed," by Dr. W. F. Sears, of Syracuse University, will be discussed by Dr. E. G. Williams, state health officer of Virginia, and Dr. W. S. Rankin, state health officer of North Carolina.

At a joint meeting of faculty members of the plant pathology departments of Washington State College and the University of Idaho the Inland Empire section of the Pacific division of the American Phytopathological Society was formed. The officers elected were: Dr. F. D. Heald, of Washington State College, *president;* C. W. Hungerford, University of Idaho, *vice president;* J. M. Raeder, University of Idaho, *secretary-treasurer.* Twenty-six representatives of the two institutions were present. The program given by the University of Idaho representatives consisted of papers by Dr. Henry Schmitz, associate professor of forest products; Dr. V. H. Young, professor of botany and plant pathology; C. W. Hungerford, plant pathologist experiment station; and J. M. Raeder, assistant plant pathologist.

A press dispatch from Oklahoma City states that an amendment prohibiting the purchase of books or copyrights teaching the theory of the evolution of the human race was inserted in the State Free Text Book Bill which passed the lower house of the legislature on February 21. Only one dissenting vote was cast against the anti-Darwinian section.

A subscriber to Science writes: "As the American Association for the Advancement of Science has definitely adopted evolution and as Science is the oficial *(sic)* organ of the American Association for the Advancement of Science you may discontinue my subscription I have no use for evolution and can not see how any inteligent *(sic)* person can have."

The Wyncote Bird Club, of Philadelphia, held a special meeting on January 23 to hear an address by Mr. R. R. Logan, president of the American Antivivisection Society. Following the lecture an open discussion was held in which Mr. Ernest H. Baynes defended vivisection. At the close of the discussion the society adopted the following resolutions:

Resolved, That it is the sense of this club that Mr. Logan has entirely failed in his attempt to show that vivisection is immoral and unethical and unnecessary to the welfare of human beings or of animals, and, be it further

Resolved, That we heartily endorse Mr. Ernest

Harold Baynes on animal experimentation and sane humane education in general.

THE University of Chicago Board of Trustees announces that Professor R. A. F. Penrose, Jr., of Philadelphia, has again contributed five hundred dollars to help provide the full eight issues during the year of the *Journal of Geology*, which he writes is "undoubtedly the best geological journal to be found anywhere."

A GIFT of £5,000 by a donor, who at present wishes to remain anonymous, has been received by the Rowett Research Institute for Animal Nutrition at Aberdeen. This sum is intended to found a library and to provide for making statistical records.

THE Board of Trustees of the American Medical Association has made the usual appropriation to further research in subjects relating to scientific medicine and of practical interest to the medical profession, which otherwise could not be carried on to completion. Applications for small grants should be sent to the Committee on Scientific Research, American Medical Association, 535 North Dearborn Street, Chicago, before March 15, when action will be taken on the applications at hand.

THE United States Civil Service Commission announces an examination to be held on March 21 to fill a vacancy in the position of meteorologist in the Signal Service at Large, U. S. Army, McCook Field, Dayton, Ohio. The entrance salary, depending upon the qualifications of the appointee, will range from $2,240 to $3,000 a year. The appointee will be expected to conduct independent research work along various meteorological lines which will include making, computing and recording meteorological observations. The examination consists of practical questions in physics, mathematics and meteorology and a rating on education, training and experience. The commission also announces an examination for aid in the Division of Marine Invertebrate Zoology, on March 7, for a vacancy in the National Museum, Washington, D. C., at $1,200 a year. Appointees whose services are satisfactory may be allowed the increase granted by Congress for the present fiscal year of $20 a month. The examination is open to men and women.

WE learn from *Nature* that the annual exhibition of scientific apparatus organized by the Physical Society of London and the Optical Society was held on January 3 and 4, at the Imperial College of Science, South Kensington. Mr. W. Gamble lectured on "Reproduction of color by photographic processes," and Professor E. G. Coker on "Recent photo-elastic researches on engineering problems. The lectures were illustrated by experiments. More than fifty firms exhibited apparatus and a number of experimental demonstrations had been arranged. Invitations to attend the exhibition were given to the Institution of Electrical Engineers, the Institution of Mechanical Engineers, the Chemical Society, the Faraday Society, the Wireless Society of London and the Röntgen Society.

SIR KENNETH D. MACKENZIE, Bt., presided on January 3 at a meeting of scientific men held at Burlington House, at which it was decided to form a Scientific Expeditionary Research Association. He said that its object would be to facilitate and promote scientific research by means of expeditions to all parts of the world. Societies and institutions not endowed with funds to enable them to dispatch research expeditions had usually to depend on public subscriptions, but an association of this kind could make itself responsible for raising the necessary money. It would have an advisory council composed of members of the councils of all the scientific bodies interested in or affiliated to it. It had been decided to organize a research expedition to the South Pacific Ocean, to start in the early summer and last about ten months. Representatives of the societies concerned would be taken on this trip, and a limited number of fellows of the association interested in science, who might desire to avail themselves of this opportunity for private study, would be permitted. He suggested that the cost would be close on £45,000.

GERMANY'S greatest user of coal is the Federal Railway, which formerly was able to utilize only 55 to 70 per cent. of its combustible material, the remainder (cinder and ashes) having been regarded as worthless. In order to make use of this waste, which is said to contain 50 per cent. or more combustible material, about two years ago the railway adopted the Meguin system of recovering coal from ashes. According to a report by the United States

consul at Frankfort on Main, thirteen large works, with a capacity for handling 420,000 tons of cinders and ashes annually, are now in operation or under construction. The amount of pure coke obtained is estimated at 164,000 tons, with an average calorific value of 5,500 units, compared with 7,000 units for good hard coal. The fine coke, with the addition of fine coal and hard pitch, is used in making briquettes, about 74,000 tons of coke briquettes being thus obtained, with a calorific value of 6,500 units. In addition to this, 256,000 tons of non-combustible clean slag are obtained; this serves for the manufacture of 130,000,000 slag stones, which are employed in building.

William Henry Hudson, the British author and naturalist, writer of "British Birds," and numerous other works on natural history, whose death on August 18 at the age of eighty years has been reported in Science, left an estate of the gross value of £8,225. The testator directed that all his MSS., notebooks and letters, and any scraps of written paper (unless specially marked for publication, in which case they are to be offered first to his publishers, Messrs. J. M. Dent and Sons) should be destroyed, and after providing for a number of legacies to friends, amounting in all to about £500, the residue of his property is left to the Royal Society for the Protection of Birds, to be utilized in accordance with the terms of a paper writing dated March 31, 1921, deposited with his will, and reading as follows: "The money I leave to the Royal Society for the Protection of Birds is to be used exclusively for the purpose of procuring and printing leaflets and short pamphlets suitable for the reading of children in village schools. The leaflets are to be composed more or less on the lines of those I have written for the society; each is to be illustrated with a colored figure of a bird, the writing is to be not so much "educative" or 'informative' as 'anecdotal.' This, I find, is the easiest way to attract the child's attention to the subject. The colored picture, the story told, excite that interest in and love of the birds which leads to their protection. I think the society should print two or three leaflets of this kind each year, if not more. For the first year or two the interest on the money must suffice, afterwards the capital may be used as required. But I have the hope that the capital may be added to by-and-by by others, so that these publications, which I think are peculiarly well suited for distribution on Bird and Tree Day to all the schools taking part in this festival, may be kept up for an indefinite period."

A correspondent to the London *Times* writes: "An illustration of the great difficulty which scientific societies are experiencing in finding money for the publication of memoirs as the result of the increased cost of printing was contained in the presidential address delivered by Major P. H. Hepburn at the annual general meeting of the British Astronomical Association. Major Hepburn said that the Variable Star Memoir, containing a large number of observations made by members of the Variable Star Section of the association from 1914 to 1919, had been ready to print for the past year. It would cost about £400. Towards this sum individual members had promised £175 and the association had earmarked £100. It was hoped that it would be found possible to put the printing of the memoir in hand before the end of the year. It may be added that Professor H. H. Turner and several well-known continental and American astronomers have urged the early publication of this memoir, which will form a continuation of the quinquennial series published since the beginning of the century by the association. In order to accumulate funds for the purpose it has been necessary to postpone publication of memoirs on other subjects. The work of the Variable Star Section has achieved international recognition for the accuracy of the material it provides for the study of the light fluctuations of long period variables."

We learn from the London *Times* that after an interval of two years the *Botanical Magazine* has made a reappearance under the auspices of the Royal Horticultural Society, for whom Messrs. Witherby have just published Part I of a new volume (148). But slight alteration has been made in the form of the magazine, and the familiar engraving of the Palm House at Kew Gardens occupies its accustomed place on the front cover. The plates in the new part are the work of three artists, and, in general, their execution exhibits

a welcome improvement on that of those in the last few volumes of the old set. There is, too, a more liberal allowance of space for the letterpress relating to the various plates, of which the number in each volume is to remain at forty-eight. The unofficial relations which have existed for so long between Kew and the *Botanical Magazine* have not been altogether severed, as, under the new régime, the editing is in the hands of Dr. Stapf, late keeper of the herbarium at Kew. The *Botanical Magazine* appeared without a break since its first appearance in 1787 till the completion of volume 146.

UNIVERSITY AND EDUCATIONAL NOTES

UNDER the will of Mrs. Alice H. Plimpton, who died in Norwood, recently, $50,000 is donated to Harvard University, of which $30,000 will go to Harvard College and $20,000 to the medical school.

TRINITY COLLEGE, Hartford, Connecticut, has received a bequest of $100,000 by the will of the late George E. Hoadley. This brings the amount collected for the Trinity centennial fund to $650,000.

IN connection with celebration of the eighty-fifth anniversary of its founding, which took place on February 22, DePauw University has started a project to raise one million dollars for endowment and a half million for buildings and equipment.

THE Agricultural School of the University of Cambridge will receive through the Ministry of Agriculture and Fisheries £30,000 from the development commissioners to provide for a chair of animal pathology. On the professor being appointed, he would be required to prepare a scheme for the development within the university of the study of the diseases of farm animals. For an approved scheme the commissioners would be prepared to find a capital sum of about £25,000 for buildings, the sites to be provided by the university.

DR. ROBERT E. VINSON, president of the University of Texas, will succeed Dr. Charles F. Thwing as president of Western Reserve University.

DR. R. A. PETERS, lecturer in biochemistry in the University of Cambridge, has been elected to the Whiteley professorship of biochemistry in the University of Oxford.

DR. RAFFAELE ISSEL, son of the late Professor Arturo Issel, the geologist, has been appointed professor of zoology in the University of Genoa.

DISCUSSION AND CORRESPONDENCE

DESTRUCTION OF THE POLARIZATION OF RESONANCE RADIATION BY WEAK MAGNETIC FIELDS: A NEW MAGNETO-OPTIC EFFECT

THE earlier studies of the resonance radiation of mercury vapor in exhausted quartz tubes by one of the present writers showed no traces of polarization, even when the exciting light was polarized. Recent experiments by Lord Rayleigh apparently indicated that polarization existed in that part of the excited column at some little distance from the window at which the beam entered, in other words when the excitation was produced by light from which the core of the 2,536 line had been removed by absorption. This observation was not verified in experiments made by one of us last spring and published in a recent number of the *Philosophical Magazine*. The polarization was found to be strong and of uniform percentage right up to the window at which the beam entered.

On commencing a further study of the phenomenon we found it impossible to produce as strong polarization as was indicated by the earlier experiments, and after varying the conditions in every conceivable manner we finally found that the disturbing factor was the magnetic field of the earth, the polarization rising to a very high value (90 per cent.) when the magnetic field of the earth was compensated by a large solenoid carrying a feeble current. In the absence of the solenoid the percentage of polarization dropped to fifty or less. This appears to be a new magneto-optic effect, and is manifested only when the magnetic field is parallel to the magnetic vector of the exciting light and perpendicular to the beam of exciting rays. A field of only five or six times the strength of the earth's field practically destroys the polarization. Discrepancies found previous

to the discovery of this effect were due to the fact that in some cases the apparatus faced north and south, and in others east and west. Lord Rayleigh's observation was doubtless due to the stray field of the electro magnet which was used to flatten the discharge against the wall of his quartz lamp.

R. W. WOOD AND
ALEXANDER ELLET
THE JOHNS HOPKINS UNIVERSITY
JANUARY 31, 1923

RATE OF MOVEMENT IN GLACIERS OF GLACIER NATIONAL PARK

IN consequence of letters sent to the U. S. Geological Survey, I send you the following note for publication:

I have hoped at some time to be able to make some careful measurements of the movement of the glaciers in Glacier National Park, as this is a matter of interest to all the tourists, but I do not know of any such that have been made thus far.

In my pamphlet on Glaciers of Glacier National Park (published by the National Park Service, 1914) I described (p. 6) some very crude measurements which I made in 1913 on Blackfeet Glacier, on Sperry Glacier (p. 15), on Chaney Glacier (p. 35), and on Vulture Glacier (p. 39). In August, 1920, I made similar crude measurements on Grinnell Glacier. Starting at the moraine on the north margin of the lower front of the ice I set spikes in the ice at four places along the frontal edge of the glacier and carefully measured the distances to marks made on the adjacent exposed bedrock directly in front. No. 1 was at the moraine where no bedrock was exposed, so a rock marker was set up. No. 2 was just south of the point where the main creek issued from below the ice. No. 3 was some distance farther north, and No. 4 near the ice cave which was then near the middle of this lobe where there was no moraine. The markers were set between 12:30 and 1:15 P.M., August 26, 1920, and the distances were measured at 4 to 4:13 P.M. of the same day. Again on August 30, after four days, mostly of chilly, rainy and snowy weather, I remeasured the distances with the results shown in the accompanying table. At No. 1, the spike had then fallen out of the hole in the ice but was stuck back in and the distance measured. At No. 2, the spike, though still in the hole, had tipped over so that the measurement is only approximately correct. The apparent movement on the bright sunny afternoon of August 26 ranged from 0 to ¼ inch, time ranging from 2¾ hours to 3 hours and 36 minutes. The total movement in time ranging from 4 days, 1 hour and 55 minutes to 4 days, 2 hours and 8 minutes, ranged from 1 inch to 4¾ inches. It is interesting to note that, as would be expected, the movement, small as it is, is increasingly greater from the side to the middle of the most advanced part of frontal lobe.

MEASUREMENTS OF ICE MOVEMENT IN GRINNELL GLACIER, AUGUST 26 TO AUGUST 30, 1920

No.	Aug. 26, Markers set	Distance	Aug. 26, time remeasured	Distance	Time elapsed	Distance ice moved
1	12:37 P.M.	66⅞ in.	4:13 P.M.	66¾ in.	3 hrs. 36 min.	⅛ in.
2	12:53 P.M.	50 in.	4:06 P.M.	50 in.	3 hrs. 13 min.	0
3	1:02 P.M.	35¼ in.	4:03 P.M.	35 in.	3 hrs. 1 min.	¼ in.
4	1:15 P.M.	28¾ in.	4:00 P.M.	28½ in.	2 hrs. 45 min.	¼ in.

No.	Aug. 30 time remeasured	Distance	Time elapsed	Distance ice moved
1	2:45 P.M.	65⅞ in.	4 d. 2 hrs. 8 min.	1 in.
2	3:00 P.M.	48 in.	4 d. 2 hrs. 7 min.	2 in.
3	3:00 P.M.	32 in.	4 d. 1 hr. 58 min.	3½ in.
4	3:10 P.M.	24 in.	4 d. 1 hr. 55 min.	4¾ in.

These measuremeents are of course too crude to form a basis for estimating the average daily or annual rate of advance of the ice, yet I think they are of some interest.

WM. C. ALDEN

SODIUM IODIDE IN TABLE SALT

TO THE EDITOR OF SCIENCE: No comment seems necessary regarding the importance of traces of iodides for the well-being of the human body. As iodine is a permanent constituent of several human organs the iodides must be regarded as an essential food material.

Lack of iodine causes pathological changes which may become typical of certain geographical regions where local drinking water is devoid of iodides. The regular supply of the extremely small traces of iodine required by humans is easily and simply accomplished by a stroke of the pen: a food law requiring that common table salt contain a trace of iodides. In the manufacture of table salt, either from sea water or salines, iodides are present in the raw material and the incorporation of a trace of them into the sodium chloride requires no additional cost and presents no additional difficulty. By a slight change in the technic of crystallization the danger of iodine starvation would be thus eliminated once for all.

INGO W. D. HACKH

AN ENTOMOLOGICAL ANTIQUE

RECENTLY the California Academy of Sciences has received through the kindness of Colonel John R. White, superintendent of the Sequoia and General Grant National Forests, and Mr. Joseph D. Grant, member of the board of trustees of the academy, a section of an eleven-foot log of the Big Tree *(Sequoia gigantea)* from the Giant Forest, Tulare County, California. On examining this section I noticed that the tree of which this was a section had been struck by lightning about twelve hundred years ago and had then become infested by the larvæ of some wood-boring beetle. Later the tree had grown over the infested area and completely covered it with a growth of healthy normal wood, thus completely sealing up the work of the beetles. It occurred to me if I could secure some of this infested wood I might discover the dried remains of some of the beetles and thus be enabled to compare them directly with the same species as now found in this forest and learn if any change had occurred in the species during these twelve hundred years. I therefore went at once to the Giant Forest and through the kind assistance of Colonel White and his efficient helpers was able to secure a number of pieces of the infested wood from this portion of the log. On examining these in the laboratory I dug out two fairly complete specimens of *Trachykele opulenta* Fall, one shriveled larva of the same and the remains of two hymenopterous parasites associated with them. Later these specimens of the beetles were compared very carefully by Dr. E. C. Van Dyke and Mr. H. E. Burke with specimens of the same species in Mr. Burke's collection which were recently taken in the same forest and on the same species of tree now living there. The result of this comparison reveals the fact that this species has undergone no appreciable change during these twelve hundred years. This species is somewhat variable, but Mr. Burke has specimens that agree in every detail with the fragments taken from the log.

Some details regarding this redwood tree may be of interest. It started as a seedling in the year 217 A.D. When 421 years old it was struck by lightning, stripping the bark and burning the wood for a width of about one foot down the length of the trunk. This burned area became infested by the *Trachykele* larvæ and was mined to a depth of about two inches. The tree at once began covering the wound with a new growth of wood and this process was completed in about fifty years, since which time the work of the beetles has been hermetically sealed within the heart of the sound living tree. A period of 1,279 years elapsed from the injury to the tree, and probably first infestation of the beetles, until the tree fell in 1917. As these beetles must have been dead in their galleries before being sealed by the growth of the tree they certainly represent the species as it was more than twelve hundred years ago. It must, of course, be recognized that *Trachykele opulenta* pertains to an archaic type, perhaps the most primitive of our Buprestids, and undoubtedly the characters of the species had become well fixed long before the Christian era. In some more plastic group the results of such a comparison might have been very different. I should add that when it fell this tree was sound to its roots, that these beetles were taken from a point about forty feet from the ground level, and that I was able to follow the work of the insect for a distance of about fifty feet up the trunk beyond this point by the sawing of the log during the past summer.

EDWARD P. VAN DUZEE
CALIFORNIA ACADEMY OF SCIENCES

AYMARA TYPE OF HEAD DEFORMATION IN THE UNITED STATES

The "Aymara" type of head deformation was produced by the application of pressure by a circular band passing over the forehead and under the occiput in the newborn infant. It was practised extensively by the Aymara people of Peru and Bolivia, radiating from the Andes to the west coast, towards Chile, and up to the Atlantic coast in Argentina.

A deformation of the same fundamental type, but somewhat different in details, was practised so far as hitherto known in only one spot in North America, namely on Vancouver Island; no specimens bearing plain traces of it were ever recorded or known of from any other part of the northern continent.

In 1919, the U. S. National Museum received from Mr. M. C. Long, of Kansas City, Missouri, an adult female skull which had been found alongside the Missouri River "in riprap work" along the Missouri-Pacific tracks, near Lexington, Missouri. This skull, which is considerably mineralized, presents unmistakable traces of a moderate circular frontal compression, with a medium bulge above this compression, a secondary broad post-coronal depression, and some flattening of the lower part of the occiput—in other words a characteristic form of a moderate "Aymara" deformation.

On January 17, this year, the National Museum received from Mr. R. S. Knowlson, of Kansas City, the remains of a female Indian skull found under an overhanging cliff and in front of the entrance to a small cave near Noel, Missouri. This skull, which is not mineralized, shows also plain traces of a moderate "Aymara" deformation. The grade and type of the deformity are much like those in the skull from Lexington. Both differ in secondary details from the type found in Vancouver. Noel is about 180 miles south from Lexington.

The two skulls may precede in age the late prehistoric and historic Indians of Missouri, who practised no deformation. It would be premature to speculate on their identity; their discovery, however, in these regions is highly interesting and may prove of importance.

Aleš Hrdlička

U. S. National Museum,
Washington, D. C.

SCIENCE AND COMMERCIALIZED ATHLETICS

Probably no member of the American Association for the Advancement of Science will dissent from the opinion that it is at times desirable to scrutinize the use of words and titles in common use and to attempt to follow their legitimate meanings and implications.

Is our "Association for the Advancement of Science" a passive or an active one? Is it restricted or comprehensive in its policy? Is it superficial or fundamental in its scope? What is the meaning of "advancement" as an object of its existence?

In this connection "advancement" means to me six things: first, improvement of environmental conditions for scientific work (anywhere and everywhere); second, increase in the number of competent scientific workers; third, increase in the usefulness (beneficial results) of science to the whole people; fourth, increase in the influence of science in human affairs; fifth, accumulation and intelligent use of funds for scientific purposes; sixth, promotion of mutual aid and mutual understanding amongst scientific workers in all lines with a view to substantial unification of the scientific world.

Again and again in the past twenty years some scientist (not to mention many other people) has recorded a protest against the growing menace of *commercialized* athletics in our educational institutions. Such protests have appeared in various scientific publications as well as in other places and many of them have also been delivered before scientific meetings. In Science for May 19, 1922, appeared a masterpiece of such protest from the pen of Professor Edward G. Mahin of Purdue University. I suppose that every member of our association knows the truth of his assertions and that almost all endorse his very moderate views and conclusions.

As a matter of fact Professor Mahin distinctly understated the case in two ways. In the first place he did not make distinct the point that the ordinary student is frequently or constantly harassed by demands for money for the use of the parasitic or predatory sporting element and that he is even more frequently disturbed by demands upon his time for "rooting" and other "support of the team."

That is to say, Dr. Mahin did not make it clear that from the moment they enter college most students are under drastic coercion tending to destroy their initiative, break their spirit and bring them into dull submission to destructive interests.

In the second place Dr. Mahin gave no attention to the bad condition in schools below university or college grade. Matters are bad enough in higher institutions, but, in truth, the mischief is often done before a youngster reaches college. He is discouraged by the outspoken contempt of the parasite for the "grind." He is impressed by the success of the bluffer or shirker supported by the sporting group. He is intimidated by the bluster or actual physical and social injury of the special interests in his school. He is made suspicious of the motives of other people. He is deprived of the poise and self-confidence so necessary in a good scientist. He is disgusted at the constant demand for money to support those creatures whom he knows to have no interest in either the school or in education.

I charge that the American Association for the Advancement of Science is derelict in its duty and false to its aims so long as it shuns active opposition to such evils. I also consider the association unscientific in its procedure when it tries to add to a superstructure while neglecting to repair its decaying foundation.

Dr. Mahin has clearly stated the ways in which *commercialized* athletics makes bad environment for scientific work. Most of us know cases in which science has been deprived of a competent scientific worker because of its evil influence. Every one of us can find evidence immediately at hand showing that *commercialized* athletics is conducted in open and contemptuous disregard of physical and mental hygiene. It is also true that *commercialized* athletics hinders accumulation of resources for scientific work and particularly diminishes the rewards of the scientific worker.

So much for the relationship of unhealthy amusement to "Advancement of Science." Personally I am intensely interested in the fact that the boy or girl who wishes to get a maximum of scientific training on limited resources is *coerced* into paying varying amounts of money and time and energy to the support of the socially and educationally and scientifically destructive activities of the sporting fraternity.

Individually or collectively 10,000 scientists ought to be able to exert a wholesome influence in these matters, not only for the good of science but for the welfare of our country. In fact it is disgraceful that such appeals as that of Dr. Mahin do not bring *action* as well as silent approval.

W. E. ALLEN

THE SCRIPPS INSTITUTION
FOR BIOLOGICAL RESEARCH

METHODS OF THE CARNEGIE INSTITUTION

TO THE EDITOR OF SCIENCE: President Pritchett's lamentations regarding the woes of the administrators of great benefactions are perhaps the natural reaction of a kindly, just and generous man who, in the nature of things, has to say "no" more often than he can say "yes." When the Carnegie Institution was first founded I wrote the following to SCIENCE (1902, xvi, 484):

> The scholarships should be allotted to laboratories the heads of which have shown themselves competent to do research work. It is a mistake to compel men, who are presumably competent, to reveal an outline of the subject to be investigated. The greatest discoveries are often accidental observations made by trained minds. The former product of their laboratories or of their personal work should be the criterion. In this way, if one line of investigation seems fruitless, the scholar can at will be turned in another course. Thus, the Carnegie Institute may endow but not control the course of science in San Francisco. There must be no limitation to the *akademische Freiheit*.

Consider one example in which this plan was followed, the endowment of the work of Osborne and Mendel, which resulted, among many other discoveries, in our knowledge of the production of xerophthalmia when butter fat is eliminated from a diet otherwise complete, and of its cure by administration of cod-liver oil or of butter fat itself. The two workers were individual scientists, one a university professor, the other a chemist in a state agricultural station. The money was conferred because it could be productive. The men were trusted absolutely. There were no conditions, no red tape, no general uplift organization with strict rules and regulations for conduct, no publicity department, no puffing, no visiting detectives, no superior intelligence to tell them

what they ought to do. They were simply left alone to do as they thought best, and they did so. "By their fruits ye shall know them."

It seems to me that the Carnegie Institution is to be greatly congratulated on the methods of its work.

GRAHAM LUSK

TINGIIDÆ

MR. PARSHLEY (SCIENCE, Vol. LVI, p. 754) credits me with too much. I can not lay claim to any "novel idea." And I wish here to state only three facts.

First: Words like Aphiidæ have been used for a long time. See Aphiidæ, "Traité d'Entomologie Forestière," Barbey, 1913.

Second: We are here concerned not with Latin usage and with professors' opinions but with the International Rules of Zoological Nomenclature.

Third: Article 4 of these rules simply states that *idæ* is to be added to the stem. No latitude is given us. It is the writer's humble opinion that any desired modification or interpretation of this article should be made by the International Commission and not by an individual.

A. C. BAKER

BUREAU OF ENTOMOLOGY

SCIENTIFIC BOOKS

The Cactaceæ: Descriptions and illustrations of plants of the Cactus family. By NATHANIEL L. BRITTON and J. N. ROSE. Vol. III. Carnegie Institution Publication No. 248. 1922.

What Professor Wheeler irreverently calls silo and saleratus botanists, and doubtless others, often sniff in private over "the futility of spending fortunes in monographing the Cactaceæ," or any other group of plants. Whiffs of such sedition occasionally reach the outside world, but scarcely penetrate the costly shrines wherein such deeds are accomplished. It is not the purpose of this review to make the appearance of the third sumptuous volume of this greatest of modern monographic ventures either the occasion, or the excuse, to fan into a breeze the undeniable zephyr of discontent that comes from botanists who feel that a great deal too much money is being spent on them. And they are unquestionably costly, as rumors of fourteen thousand dollars spent for illustrations alone on this third volume amply testify—not to speak of the still greater cost of exploration, cultivation of specimens and years of study. So that each of these four volumes, judged by a botanical gauge of wealth, costs a fortune, and by any gauge the four of them are perhaps the most expensive of any recent botanical publication.

The completion of this volume, however, with its twenty-four gorgeously colored plates and two hundred and fifty half-tones, does make a good occasion to reiterate that the enterprise is one that only modern conditions could have produced. For in the hurly-burly of the modern educational and scientific world, the three things that can produce such a work are hard to find, and to find them together is all but a miracle. They are knowledge and the opportunity to increase it, time and money. The authors supplied the first, bringing to their work long experience, and having, in the equipment of the New York Botanical Garden, unexampled opportunity to increase it. Freedom from the rush to produce "research" as a manufacturer might produce a foundry was made possible by the far-sighted policy of the Carnegie Institution in providing sufficient money over a long period of years. The whole enterprise is one where cooperation between great institutions and individuals, willing to sink institutional or personal aims for the sake of the work, has been a conspicuous success.

As to the botanical merit of the volumes, specialized journals will no doubt report upon that in due season. All the botanical world knows that the authors are the greatest living students of the Cactaceæ, and their studies have led them into every part of North and South America, to which the group is practically confined. As something over half a million square miles of North America is a desert country, the necessity of knowing pretty accurately the cactus constituents of this flora is obvious. These volumes are, therefore, the foundation upon which all ecological, phytogeographical and physiological work on desert cacti must be based. And in spite of gentle zephyrs of doubt, such as were noted above, the logic of their preparation and the excellence of the product must be as great a satisfaction to their collaborators as the volumes

are undeniably a great contribution to botanical literature.

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SPECIAL ARTICLES

THE CYTOLOGY OF VEGETABLE CRYSTALS

While studying the mucilage cells of cacti, chiefly *Opuntia* spp., I noted the occurrence of calcium oxalate druses both in these cells and in the ordinary parenchyma cells of pith and cortex. The wording of my description[1] exposes me to criticism as to the correctness of my observations, if Professor Jeffrey's views, as expressed in a recent issue of this journal,[2] are found to be well founded. As to this, however, I venture to express doubt, and therefore oppose my own observations to those of Professor Jeffrey.

He states that in "ginkgo," the "Juglandaceæ, Cactaceæ, Begoniaceæ, Geraniaceæ, etc.," the druses (spheroidal aggregates of calcium oxalate crystals) are formed by the laying down of "crystals . . . about the nucleus, when the protoplasm of the element is still dense and unvacuolated." "The crystals in fact constitute a spiny casing which surrounds the nucleus and protoplasm." "The nucleus is therefore central to the crystal itself. Corresponding to this fact there is only one druse in each cell." My own observations lead me to the following results:

The growing buds of ginkgo are indeed very favorable material, the young leaves especially. I have had no difficulty in finding young cells in which minute druses, in diameter less than one third that of the nuclei, could be seen lying in the protoplasm, there being at this time only small sap vacuoles, or none. If a vacuole is present, the druse is usually not found lying free within it and I think it doubtful if a druse ever originates in the sap vacuole, free from the protoplasm. On this point it must be conceded that the current texts do not speak convincingly, while some of the illustrations (*e. g.*, Frank's, see Stevens, "Plant Anatomy," p. 206) are, I think, a bit too diagrammatic, if not fanciful. As the druse increases in size it may come to occupy the greater portion of the total volume of the cell, when the nucleus may be seen crowded against the cell wall and between projecting crystals of the druse. There may then be no sap vacuole recognizable, the druse being clothed with dense protoplasm, with the nucleus as described. Later, in many cases, the protoplasm disappears so that a large druse may then be seen surrounded only by a thin cell wall which has never acquired the thickness of the walls of the living neighboring cells, and which also separates from them more or less. On treatment with hydrochloric acid, the middle of the druse is dissolved more readily than the peripheral larger crystals, and if the action of the solvent is stopped, so as to make the identification of the druses still unequivocal, one can then see some granular material, derived, I believe, from the druse, but which does not stain as protoplasm. Sometimes small flocks of material, staining as protoplasm, may be seen, probably relict of the once living protoplast. I conclude that there is some colloidal material imprisoned within the druse, and this may be essential in conditioning the growth of a crystal aggregate—as the mucilage of raphide cells may do also—but that this colloidal material is the protoplast occupying the central portion of the druse I deny. Accordingly, it is no matter of surprise to find two druses in a cell—though Professor Jeffrey appears not to have found this to be the case. This happens occasionally in narrower cells, in which the nucleus may be seen; it may happen ensconced between two druses. These latter may be of the same, or different—even widely different—sizes. When very small, the projecting crystals may not be easily distinguishable.

The granular, colloidal material above referred to can be seen in many of the larger druses even before treatment with acid, and appears to have a more or less radiating form. This it may be is the material regarded by Buscalioni (*vide* Tunmann, "Pflanzenmikrochemie," p. 139) as mucilaginous.

At any rate the presence of some such material within or intimately associated with the crystalline mass has already been observed; but whether there is a specific body which

[1] *Amer. Journ. Bot.*, 6, 156-166, April, 1919.

[2] E. C. Jeffrey: "The Cytology of Vegetable Crystals," Science, N. S., 50, 566-567, May 26, 1922.

serves as a center of crystallization is an open question. I have found examples of druses which display both radial and superficial symmetry of structure, centering upon a stainable mass, which, by virtue of these features, strongly incline one to attach importance to an idea of organization which, however, lacks the support of general observability and so becomes insubstantial. It is certainly probable that *something* furnishes a "nucleus" (I here use the physical term) for radial crystallization. The most frequent origin of the druse is in the cytoplasm, and it would appear that in the absence of such a "nucleus," a minute vacuole containing oxalic acid would serve, if calcium were available. It is infrequently that one finds a druse free in a large vacuole, however, and one inclines to the former view, especially when the structure of "rock candy" is recalled, and the string which serves as the "nucleus" for crystallization. Even when druses are formed in cells with very extensive vacuolization, such as the mucilage cells in the cacti, one finds most usually that they are held in the cytoplasm, and do not lie free in the vacuole. It is therefore rather more than likely that, when this does occur, it is secondary, the druse having been thrown out into the vacuole.

Professor Jeffrey further points out as a "surprising fact" that under the influence of the protoplast included within the druse the cell wall grows in size to accommodate the growing crystal. In opposition I venture to submit my observation that the shape of the druse is within limits determined rather by that of the enclosing cell wall, and can show preparations in which long crystals have grown into the more roomy end of the cell, while only short ones are found where their ends would more quickly impinge upon the cell wall. When cells which have died are observed, the cell wall, which, as above said, is thin, separates from the adjoining cell walls and collapses more or less, thus coming to form a closer investiture, conforming to a greater or less degree to the contour of the crystalline surface. Definitively, protoplasm has disappeared, and with its crystal ceased. But assuming the fact to be such as Professor Jeffrey asserts, his call of disappearance, growth in the cell wall and attention to the serious problem of the growth of the cell wall removed from immediate contact with the protoplast seems supererogatory. The variously elaborate investitures of spores and analogous bodies supply examples of such difficulty which the mechanistic mind can not, nor, I believe, desires, to minimize.

I have spoken above only of ginkgo. I find, however, nothing in the Cactaceæ, Orchidaceæ, Iridaceæ, Begoniaceæ or in any other material at all out of harmony with what I have found there. In the begonias, in particular, one may find in the calcium oxalate containing cells not merely druses, but various conditions ranging to single crystals. Although it is well known that "inclusions" may occur in crystals, such would be easily enough demonstrable. Here it may be added that by breaking open the large druses, cytoplasmic inclusions if present would be readily exposed to stains. But preparations made in this way, as well as by partial solution by acids, have equally yielded nothing to substantiate the views of Professor Jeffrey.

Of course, any attempt to discuss the problem of the origin and mode of growth of crystals in living cells would involve many more facts than those connected merely with the druse; and the particular contribution of the living substance is the matter above all in which we are interested. In spite of the implications of Professor Jeffrey's concluding remarks directed at the mechanists, it still remains legitimate to use what we do know to attempt to explain what we do not. For example, it is permissible to argue that the mucilage of raphide cells, because of its emulsoid character, furnishes a suitable nidus for the growth of acicular crystals, and it is quite possible that appropriate experiments *in vitro* would show that such crystals can be produced thus. The exceedingly long raphide cells in the petals of *Œnothera* suggest strongly that a capillary glass tube filled with a suitable emulsoid might furnish the mechanism required, but until some one succeeds in doing this, we may permit ourselves to marvel at the living mechanism, so long only, however, as this attitude does not paralyze experimental effort.

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BACTERIAL SPOT OF COWPEA

A rather destructive bacterial disease of cowpeas characterized by spots on the leaves, stems and pods has been noted in Indiana since 1919. On the leaves the spots are irregularly circular and one to three millimeters in diameter with a maroon border and buff center. The lesions are not noticeably delimited by the veins. Young lesions are greasy and watersoaked. On the pods the spots are irregularly circular, one to eight millimeters in diameter, and maroon in color, often with a sunken center and a watersoaked border. Early infection may cause a constriction of the pod and stunting of the distal portion. Seeds under pod lesions may be stunted, shriveled or discolored. Dark red, elliptical to linear, sunken lesions are formed on the petioles and stems. In addition to lesions on cotyledons, first leaves, hypoctyls and epicotyls, localized vascular infection and partial wilting may occur among seedlings grown from infected seed.

Numerous isolations and successful inoculations have proved that the disease is due to an apparently undescribed species of bacteria which may be briefly characterized as follows:

Bacterium vignæ, n. sp.[1]

Cylindrical rods, rounded at ends, solitary or in pairs; individual rods 1.5 to 2μ by 0.5μ; motile by 1 to 5 polar flagella at one or both poles; ærobic; no spores; no capsules. Gram negative; most readily stained with gentian violet.

Superficial colonies on potato agar, round, smooth, shining, raised, pulvinate, or umbonate; finely granular, often showing a concentric pattern, grayish white in reflected light, slightly greenish fluorescent in transmitted light.

Gelatin rapidly liquefied; casein digested and no acid produced in milk; nitrates not reduced; no gas with various carbohydrates and no acid except for small amount with dextrose and saccharose; starch not hydrolized.

[1] According to Migula's classification and the revision adopted by the committee of the Society of American Bacteriologists (Winslow, C.-E. A., Broadhurst, Jean, Buchanan, R. E., Krumwiede, Charles, Jr., Rogers, L. A., and Smith, G. H.: "The Families and Genera of the Bacteria," *Jour. of Bact.*, 5: 191, 229, 1920) the combination would be *Pseudomonas vignæ* n. sp.

Growth and greenish pigment formation in Fermi's and Uschinsky's solutions. No growth in Cohn's solution. Slow liquefaction of blood serum and Loeffler's blood serum.

Growth inhibited by 5 per cent. sodium chloride. Growth in +12 and —15 broth and in p_H 4.8. Greenish pigment formation in alkaline broth.

Thermal deathpoint, 50° C. Killed by one hour's exposure to sunlight. Slowly killed by freezing in water. Quickly killed by desiccation on glass, but very resistant to desiccation on cowpea seeds.

Group number, 211.2322033.

Pathogenic on *Vigna sinensis* (L.) Endl.

The disease is seed borne and may be avoided, it is believed, by using seed from disease-free pods. A more detailed account of this disease is forthcoming.

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James B. Kendrick
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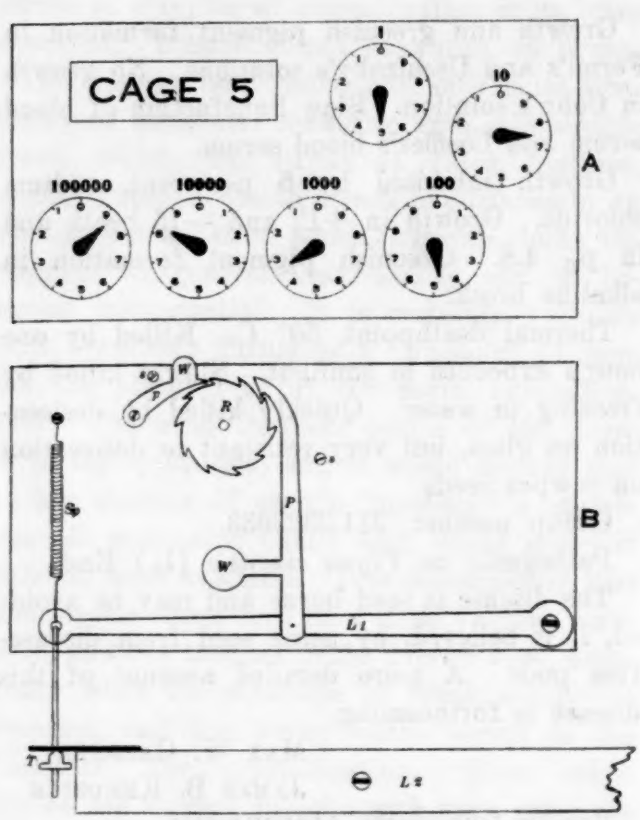
A REVOLUTION RECORDER

In Volume 2 of the *Anatomical Record,* 1908, I described an apparatus for recording the activity of small mammals. In that apparatus the number of revolutions of the cage was recorded in hours, minutes and seconds by a clock. The task of converting thousands of readings of the clocks into their equivalent numbers of revolutions has been so tedious and time consuming that a new device which gives the number of revolutions at reading has been substituted for the clocks.

This device consists of a gas meter index so modified that successive dials have a ratio of 1 to 10. A new dial (10, figure A) has been introduced and the drive gear on shaft "1" has been changed to make the ratio 1 to 10. The two figures A and B show the front and back view respectively. A ratchet wheel (R, figure B) with ten teeth is attached to the shaft of dial 1. The two pawls (P and p) are so weighted (w) as to keep them in contact with the ratchet wheel. A stop (s) prevents the pawls from being thrown completely off the ratchet wheel. The long arm of the lever (L 2) (not shown in the figure), which rests on the axle of the revolving cage, is lifted each revolution by a rod on the end of the cage. This



causes a downward pull of the lever (L 1) to which pawl (P) is attached, the ratchet wheel is turned the distance of one tooth, and the hand on dial 1 moved one space. A spring (Sp.) lifts the lever (L 1) to its former position after lever (L 2) has returned to the axle of the cage. The number of revolutions made by the cage are thus automatically recorded in figures which can be read at a glance.

Our revolving cages were equipped with these counters about a year ago and we have found them very satisfactory and a saving of much valuable time.

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THE AMERICAN MATHEMATICAL SOCIETY

The fiftieth regular meeting of the Chicago Section of the American Mathematical Society, being the eighteenth regular western meeting of the society, was held at Northwestern University, Evanston, Illinois, on Friday, December 29, 1922. The meetings were presided over by Professor Coble, chairman of the section, relieved by Professors Curtiss and Dickson. The following papers were presented. The paper by Professor Moore was presented by Mr. Wilder; the papers of Professor Jackson, Dr. Camp, and the first paper of Professor Chittenden were read by title:

Ruled surfaces with generators in one-to-one correspondence: E. P. Lane, University of Wisconsin.

Some theorems on continuous curves, with special reference to continuous curves that contain no simple closed curve: R. L. Wilder, University of Texas.

An analysis of the point-set which constitutes the boundary of a complementary domain of a continuous curve: R. L. Wilder.

An uncountable non-dense closed point-set each of whose complementary intervals abuts on another one at each of its ends: R. L. Moore, University of Texas.

Closed sets of rational points on a plane cubic curve of genus one: Mayme I. Logsdon, University of Chicago.

Report on a boundary value problem of fourth order: H. T. Davis, University of Wisconsin.

The extension of the Weddle and Kummer surfaces to hyperelliptic three-ways of genus three: A. B. Coble, University of Illinois.

Associated sets of points: A. B. Coble.

The rational linear algebras of maximum and minimum ranks: L. E. Dickson, University of Chicago.

A new simple theory of hypercomplex integers: L. E. Dickson.

Symmetric forms in n variables: Arnold Dresden, University of Wisconsin.

A general class of problems in approximation: Dunham Jackson, University of Minnesota.

Abstract group definitions and applications: W. E. Edington, Purdue University.

On an infinite system of non-abelian groups of order nm^n: W. E. Edington.

On an infinite system of non-abelian groups of order nm^{n-1}: W. E. Edington.

Note on a property of abstract sets which admit a definition of distance: E. W. Chittenden, University of Iowa.

The Schmidt linear differential forms of a limited bilinear form in infinitely many variables: E. W. Chittenden.

On a form of the property of Borel-Lebesgue which is independent of the closure of derived classes: E. W. Chittenden.

Concerning an expansion in the restricted problem of three bodies: K. P. Williams, University of Indiana.

Expansions in terms of solutions of partial differential equations: C. C. Camp, University of Illinois.

Arnold Dresden,
Secretary of the Chicago Section